AN APPARATUS FOR DISPENSING OF STACKED OBJECTS, A METHOD FOR DISPENSING STACKED OBJECTS AND A SYSTEM COMPRISING AN APPARATUS FOR DISPENSING

FIELD OF THE INVENTION

The invention relates to an apparatus for dispensing of stacked objects in a predetermined dispensing direction, the dispensing apparatus comprises at least one guiding means intended for guiding the stack of objects and at least one dispensing unit intended for repetitive dispensing of at least one object at a time. The dispensing unit furthermore comprises a first supporting member and a second supporting member intended for supporting a first object and a second object, respectively, of the stacked objects, where the first object is an object being an outermost object and intended for immediate subsequent release in the predetermined dispensing direction, and where the second object is an object being an object neighbouring the first object and situated between the first object and the remaining stack of objects. The invention further relates to a method for dispensing of stacked objects and top a system comprising an apparatus for dispensing.

BACKGROUND OF THE INVENTION

The invention relates in general to dispensing equipment and, more particularly, to an apparatus, method and system for holding a stack of objects and dispensing them one or more at a time in a predetermined direction, onto a predetermined location and in a predetermined sequence.

Many types of products such as ice cream, meat products and prefabricated meals are packaged in objects, which have a tapered side wall. These objects are constructed with this configuration so that they may be packed and shipped in space-saving nested stacks. The stack of objects also provides a convenient method of loading the objects into a dispensing apparatus. The dispensing apparatus may be positioned over a movable mechanism such as a conveyor belt, which transports the objects from the nested stack to a filling station where the food product or other product is filled into a cavity of the objects. The thus filled object is subsequently sealed by application of a lid or other sealing device and further processed as needed.

To achieve high speed filling and subsequent processing, the objects must be dispensed reliably and at a high rate of speed from the nested stack in the dispensing apparatus. Satisfactory performance, however, is difficult to achieve, among others because the objects are not always aerodynamically stable, they may tumble as they fall from the dispensing apparatus towards the subsequent location, resulting in jamming of the

apparatus and increased material losses and operational costs. Moreover, precise timing of the release of an object from the nested stack is difficult to accomplish because of frictional forces and vacuum forces holding the object to the stack. Failure to dispense the object on time may result in further material and/or operational losses.

Construction of a suitable dispensing apparatus, which provides rapid and accurate dispensing of objects, is difficult because the apparatus must support the stack of objects while at the same time releasing the first object in the stack. To achieve higher delivery speeds and greater reliability, conventional dispensers have utilised various mechanisms for the dispensing of the objects.

US 5,067,308 describe a method and an apparatus, where the apparatus is provided for supporting and dispensing of a nested stack of containers. This is done by a number of supporting plates being activated in a certain cycle to engage with and release of the containers along with a set of activatable mechanical trusting fingers to help release the lowermost container. However, the speed, the control, the maintenance and the reliability of this device and others alike is less than desired for use with many high-speed filling processes. There is a great demand to the control of the individually separate supporting and releasing means, such control being difficult and being prone to failure.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a dispensing apparatus with a mechanism for supporting a stack of nested objects and for dispensing at least one object at a time with greater speed and reliability than conventional dispensing devices so that higher processing speeds and greater dispensing reliability may be obtained.

It is also an object of the present invention to provide a method for dispensing individual objects from a nested stack with higher speed and greater reliability than afforded by conventional methods so that other related operations subsequent to the dispensing may proceed at faster rates and with fewer interruptions.

It is also an object of the invention to provide a dispenser that is mechanically simple and incorporates an improved control as part of the means for achieving the objects.

These objects may be obtained by a dispensing apparatus comprising
- at least one guiding means intended for guiding the stack of objects and
- at least one dispensing unit intended for repetitive dispensing of at least one object at a time and said dispensing unit furthermore comprising

- mutually integrate first supporting member and second supporting member intended for supporting a first object and a second object, respectively, of the stacked objects,
- where the first object is an object being an outermost object and intended for immediate subsequent release in the predetermined dispensing direction,
- where the second object is an object being an object neighbouring the first object and situated between the first object and the remaining stack of objects,
- said first supporting member and said second supporting member being spaced apart and exhibiting a mutual displacement in the predetermined dispensing direction,
- said mutual displacement being sufficient for the second supporting member, during operation of the apparatus, to support the second object, when the first supporting member, during operation of the apparatus, releases the first object.

A dispensing apparatus comprising these few features is surprisingly sufficient for performing a proper dispensing of the objects. However, the invention having these few features are not only enough for obtaining a proper dispensing, it results in a dispensing speed being up till twice the dispensing speed of known dispensing apparatuses. Also, the reliability during operation of the apparatus according to the invention is substantially increased because of the fewer and mechanically more simple features of the invention.

The dispensing unit of the invention may either perform a rotational displacement or a longitudinal displacement during dispensing. The rotational displacement may be a continued rotation or may be a rotation in one direction followed by a rotation in the opposite direction. According to a preferred embodiment related to the aspect of a rotational displacement of the dispensing unit, dispensing of at least one initial first object in the predetermined dispensing direction is achieved by the dispensing unit rotating an angle in an initial rotational direction, said angle being determined by the at least one initial first object being released from the support of the first supporting member and from the stack of objects, while at the same time an initial second object is still supported by the second supporting member.

According to a preferred embodiment related to the aspect of a longitudinal displacement of the dispensing unit, dispensing of at least one initial first object in the predetermined dispensing direction is achieved by the dispensing unit displacing linearly in an initial longitudinal direction, said linear displacement being determined by the at least one initial first object being released from the support of the first supporting member and from the stack of objects, while at the same time an initial second object is still supported by the second supporting member.In order to ensure continued dispensing of the objects and continued feed of the objects in the dispensing direction the dispensing system may comprise further means.

The further means may be a force-inducing element being positioned in an end of the stack being opposite than the position of the at least first object of the stack and substantially acting in the predetermined dispensing direction on an object being opposite to the at least first object. Alternatively or additionally such forcing means may be acting on at least some of the objects of the stack and substantially acting in the predetermined dispensing direction on at least one of the objects of the stack. Alternatively or additionally means for securing a continued feeding of objects in the dispensing direction may be an integrate element. This integrate element providing both a guiding and a forcing along the outer circumference of the objects, alternatively within an inner cavity of the object of the stack being opposite to the at last first object. Such means may e.g. be provided by blowing air towards the object in the dispensing direction and/or a spring load provided on the inside or the outside of the objects.

In order to ensure the same pressure on the lowermost object in the dispensing direction two dispensing units may be placed on top of each other. This may be provided by a second number of dispensing units are placed in a position before, seen in the dispensing direction, a first number of dispensing units, wherein the second number of dispensing units is intended for dispensing a predetermined number of objects from a second stack of objects to a first stack of objects, where said first stack of objects constitute the stack of objects primarily intended for being dispensed, and where said second stack of objects constitute a secondary stack of objects acting as a buffer for the first stack of objects.
The invention also relates to a method for supporting a nested object stack and dispensing individual objects from the stack. The method comprises the steps of:

(a) guiding the objects of the stack in a plane perpendicular to a predetermined dispensing direction
(b) initially supporting an at least first object by a first supporting member and supporting a second object and the remainder of the stack by a second supporting member,
(c) supporting an initial second object by the second supporting member and thereby supporting the stack by the second supporting member
(d) displacing the first supporting member and the second supporting member, said displacing of the supporting members resulting in
(e) releasing the at least first object from the support by the first supporting member, and thereby dispensing the at least first object from the stack,
(f) releasing the stack of objects from the support by the second supporting member, thereby displacing the stack of objects in the dispensing direction, resulting in
(g) supporting the initial second object by the first supporting member and thereby supporting the stack of objects by the first supporting member,

(h) repeating steps (c) through (g) for dispensing additional objects from the stack of objects.

A method involving these steps results in a precise, a safe and a fast dispensing of objects. This result is achieved by a dedicate sequence of steps safe-guarding that the dispensing of the first objects is performed only after the second object and the rest of the stack is supported, and that the second object and the rest of the stack is shifted to being supported by the first supporting member, only when the first supporting member is in position to do so. There is absolutely no need for controlling these individual steps because the first supporting member and the second supporting member are mutually non-displaceable. Therefore, the mutual relationship between the supporting members is fixed.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail with reference to the following, where

fig. 1 is a cross-sectional view of an embodiment of the invention intended for dispensing objects by a dispensing displacement achieved by rotation.
fig. 2 is a plane view of the embodiment of the invention seen along a preferred dispensing direction
fig. 3 shows two dispensing units according to an embodiment of the invention when supporting a stack of objects.
fig. 4 shows the dispensing units according to the invention, when a first object has been released from the stack of objects,
fig. 5 are plane views seen from above of embodiments of the first supporting member and the second supporting member,
fig.6 is a perspective view of the second supporting member according to an embodiment of the invention, and
fig.7a-7c show embodiments of the second supporting member according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 is a cross-sectional view of an embodiment of a dispensing apparatus intended for dispensing of objects by a dispensing displacement achieved by a rotation of a dispensing unit. The figure shows a first frame plate 1, which is connected with a second frame plate 2 by connecting frame members 3 and nuts and bolts. From the figure, two dispensing units 4 can be seen with a first supporting member 5 and a second supporting member 6 of the dispensing units 4. The first supporting member 5 and the second supporting member 6 are spaced apart though being assembled for constituting a common integrate

unit, making the first supporting member 5 and the second supporting member 6 mutually non-displaceable and in common referred to as a dispensing unit. The mutual displacement of the first supporting member 4 in relation to the second supporting member 6 may be adjusted depending on the spacing between the objects of the stack.

A predetermined dispensing direction of the apparatus is a direction from above and downwards. The mutual displacement between the first supporting member and the second supporting member must be the same as the mutual spacing between the objects of the stack. The adjustment of the first supporting member and the second supporting member may be easily accomplished by replacing an element sandwiched between the supporting members, selecting an element having a thickness the same as the mutual spacing between the objects of the stack.

The first supporting member 5 and the second supporting member 6 of each of the dispensing units 4 is attached to a common shaft 7. On the shaft, a wheel 8 is positioned and intended for interaction with a belt or a chain 9, said belt or chain 9 intended for driving the shaft for making the shaft rotate. In the embodiment shown, a toothed belt is selected and the wheels 8 are toothed wheels, the tooth gearing of the wheels being in mesh with the tooth gearing of the belt. A number of dispensing units are interconnected and driven by the same belt making each of the dispensing units rotate when the one and same belt moves.

The objects to be dispensed are shown, also in a cross-sectional view, as being suspended at the bottom of the apparatus, The objects may be made out of various materials such as plastic, metal, paper and with a square, a round, a triangular, an elliptical or any other shape when seen from above (see fig. 2). Examples of such objects are containers, containers with lids hinged to the container, cups, lids, buckets etc.

Fig. 2 is a plane view of the embodiment seen in fig. 1 and seen from above in relation to the predetermined dispensing direction. The figure shows two pneumatic cylinders 10 and 11, which are connected to the toothed belt by a connecting element 12. The figure shows one of the pneumatic cylinders intended for activating the toothed belt and being in an extended position, while the other pneumatic cylinder is in a retracted position. The pneumatic cylinders are intended for being controlled by a suitable control unit controlling the pressurising of the cylinders. The pneumatic cylinders are kept in place in relation to the second frame plate 2 by positioning brackets 13. In the embodiment shown, two pneumatic cylinders are shown. However, as the pneumatic cylinders are double-acting, it is possible to use only one pneumatic cylinder.

Four dispensing units are shown, and all four dispensing units are connected by the one and same toothed belt being an end-less toothed belt. Guiding means 14 are provided for guiding the objects in the plane of the figure, thus being a plane perpendicular to the predetermined dispensing direction. The guiding means are guiding the objects along the outer circumference of the objects and are placed inside an opening 15 of the first frame plate 1 (see fig. 1) and the second frame plate 2. The opening 15 allows the objects to pass through the frame plate2 1,2

The four dispensing units are placed as to surround the objects to be dispensed and may be placed in the "corners" of the object (when the object comprises "corners") or may also be positioned anywhere else in relation to the circumference of the objects. The number of dispensing units may be chosen depending on for example the objects to be dispensed. The supporting members may have a shape and be positioned in the immediate vicinity of the circumference of the objects to be dispensed so as to guide the object in a plane perpendicular to the dispensing direction, i.e. in the plane of the figure. Thus, the element (see fig. 1) being sandwiched between the first supporting member 5 and the second supporting member 6 may have a diameter so that the circumference of this element is abutting an outer circumference of the objects, thereby supporting the "corners" of the objects in the plane perpendicular to the preferred dispensing direction.

Fig. 3 shows two dispensing units 4 according to the embodiment shown in fig. 1 and fig. 2,and shown in a situation supporting a stack of objects 16 by means of the first supporting member 5 of each of the dispensing units 4.

The second supporting member 6 of the dispensing unit is provided with a protrusion 17 extending in the preferred dispensing direction. The mutual distance between the first supporting member 5 and the second supporting member 6 is indicated at 18 and indicated to be substantially equal to the distance between the stacked objects indicated at 19. The distances 18 and 19 may or may not be similar. When the objects stacked in the stack are otherwise shaped as the shown objects, e.g. have another distance 19 between the objects, the distances 18 and 19 may or may not be similar. In particular, the distance 19 between the objects may be less than the distance 18 so as to separate the objects further apart. The mutual distance between the first supporting member 5 and the second supporting member 6 then equals the incremental advancement of the stack of objects 16 as a first object lowermost in the stack is released by the first supporting member 5.

However, before the first object is released from the support by the first supporting member, the second supporting member, during rotation of the dispensing unit 4, is brought into mesh with the object nested just above the first object and in the mutual

spacing between the first object and the second object. Thus, during a further rotation, the support of the first object is released, and the first object drops in the predetermined dispensing direction. Because the second supporting member at the same time is supporting the second object, the stack of objects is supported as a whole by the second supporting member, when the first object is dispensed.

Further rotation results in that the second supporting member is brought out of mesh with the stack of objects. However, before that, the first supporting member is in a position ready for supporting a new object. Thus, when the second supporting member is no longer supporting the stack of objects, the stack drops downwards and changes from being supported by the second supporting member to being supported by the first supporting member. The initial second object of the stack then becomes a subsequent first object of the stack.

Fig. 4 shows a dispensing unit according to the embodiment shown in fig. 1-3, and in a situation when a first object 20 has been released from the first supporting member and is forced in the dispensing direction by the protrusion 17 extending from the second supporting member downwards in the dispensing direction and in a situation when the stack of objects 16 is supported by the second supporting member 6.

The protrusion may have various shapes. This releasing force exerted by the protrusion onto the first object forces the object downwards faster and more reliable than if under the influence of gravity alone, thereby reducing the tendency for the object to tumble. The stability of the object during its downwards movement is also assisted by a forced release from the stack by means of the protrusion.

In the embodiment of the invention shown in FIG. 4, the top 25b of the second object is positioned as indicated, and the edge 25a of the object in the stack is positioned as shown. For the objects shown, the edge 25a does not overlap the top 25b of the second object.Fig. 5 shows the first supporting member 5 and the second supporting member 6 according to the embodiment shown in fig. 1-4. The first supporting member 5 has a first circular section 22 having a radius R5 and a second circular section 21 having a radius r5, the radius r5 of the second section being smaller than the radius R5 of the first section. The first section 22 extends over a circular extension being approximately 180° and thus the second section 21 also extends over a circular extension of approximately 180°. The second supporting member 6 has a first circular section 24 having a radius R6 and a second circular section 23 having a radius r6, the radius r6 of the second section 23 being smaller than the radius R6 of the first section 24. The first section 24 extends over a circular extension being approximately 203° and the second section 23 extends over a

circular extension of approximately 157°.When the first supporting member and the second supporting member are individually fixed as shown in fig. 1-4, the first circular section 22 of the first supporting member 5 and the first circular extension 24 of the second supporting member will overlap by 11.5° at opposite sides of the first circular sections 22,24 of each of the first sections of the supporting members. The overlap is provided in order to assure a safe and proper dispensing of the objects, i.e. dispensing of the first object of the stack at the same time as the second object of the stack is supported by the second supporting member, and subsequently forwarding the second object of the stack towards the first supporting member, when the first circular extension of the first supporting member has been released from supporting the first object of the stack.

However, it is not a prerequisite that an overlap is established between the first sections of the supporting members. It is only a prerequisite that the first section of the second supporting member is just supporting a tiny edge of the second object of the stack, when the first object is dispensed, and that the first supporting member is just supporting a tiny edge of the second object of the stack when the stack is forwarded during release of the support by the first section of the second supporting member. Accordingly, the first section of the first supporting member may extend over a circular extension smaller than 180° together with the first section of the second supporting member perhaps also extending over a circular extension smaller than 180°, or vice versa. The specific circular extension of the first sections of the first supporting member and the second supporting member depends on the actual shape and the size of the edge of the objects to be dispensed.

The leading edges of the first sections of the supporting members may be blunt as illustrated in fig. 3. This is satisfactory, if the mutual spacing between the objects is relatively large as shown in fig. 3 and fig. 4. However, if the mutual spacing between the objects is very small, it may be necessary or at least advantageous making the leading edges of the first section of the second supporting member sharp, so that the leading edge is capable of entering a narrow spacing between the objects. In a preferred such embodiment, the leading edge is made sharp and part of the first section immediately following the leading edge is formed having the shape of a wedge. By making the leading edge and part of the first section of the supporting part of the second supporting member form a shape of a wedge the apparatus, as mentioned, makes it possible to split objects with very little spacing between the levels of objects. Dispensing of such objects is further discussed in the description of fig .6 and fig.7.

Fig. 6 is a perspective view of the second supporting member 6 according to an embodiment of the invention. The supporting member is formed with a sharpened dge 26. The material extent, seen in an upwards direction perpendicular to a tangent of the edge

26 of the supporting member increases gradually, opposite to the direction of rotation. In the embodiment shown, the direction of rotation is intended for alternating and therefore the gradual increase of the material thickness is shown in both opposite directions. When providing the supporting member with a gradually increasing material thickness, an easier separation is obtained and/or a further separation is obtained of the objects in the stack from each other.

Fig. 7a-7c show embodiments of the second supporting member 6 according to the invention. Fig. 7a is a top view of the second supporting member 6. The radius of the second supporting member may be gradually increasing such as shown along the curvature 27. The gradually increase of the radius of the second supporting member provides an easier separation form each other and/or a further separation from each other of the objects in the stack. The gradually increase of the radius may be provided together with a sharpened edge 26 ad shown in fig. 6.

FIG. 7b shows two objects to be dispensed. In the embodiment shown the top 25b of the second object is positioned as indicated at 25b and the edge 25a of the object in the stack is positioned as shown. In relation to the objects shown, the edge 25a is overlapping the top 25b of the second object. A cross-section 28 of the edge of the second supporting member is shown in a situation just before the edge of the supporting member will be lifting and/or be supporting the edge 25a. The cross-sectional view may be taken from the area indicated in the top view at 26 in a radial direction.

FIG. 7c shows four alternative cross-sections of the edge of the second supporting member for lifting and/or for supporting the edge 25a. The cross-sectional views may be taken from the area indicated in the top view at 26 in a radial direction. The edge 25a may have wedge-shaped cross-sections. The cross-section 31 has a protrusion on top of the supporting member,said protrusion providing a separation of the objects. The cross-section 32 indicates an edge of the supporting member being provided with an element of a flexible material such as a tongue or sheet of metal, plastic or rubber. Providing the edge with flexible metal, plastic or rubber may increase the possibility of the system separating objects exhibiting a so-called negative overlay along the edges of the objects. Any of the described means may be used as the only means for providing a supporting or lifting means of the object, but may also be used in a combination with two or more of the ways of lifting and/or supporting the objects being described with reference to one or more of the other figures.

An alternative embodiment to the first supporting member and the second supporting member having circular sections and dispensing the objects by a rotating movement, the first supporting member and the second supporting member may have linear sections and

may be intended for dispensing objects by a longitudinal movement. Thus, a first supporting member may be provided linearly in extension of one side of the first object of the stack in a first level, and a second supporting member may be provided linearly in extension of one or another side of the second object of the stack in a second level.

The difference between the first level of the first linear and longitudinally displaceable supporting member and the second level of the second linear and longitudinally displaceable supporting member corresponds to the mutual spacing between the objects of the stack just as the individual spacing of the supporting members shown in fig. 1-4.

The leading edge and part of, or perhaps all of, the supporting members may be sharp and formed as a wedge, respectively. The distance along the longitudinally displaceable direction of the supporting members is less than the length of the edges of objects which the supporting members are intended for supporting. Thereby, it is assured that the second object, when the first object is dispensed by releasing the support of the first supporting member, is supported, and that the second object when being forwarded towards the first supporting member by releasing the support of the second supporting member, will be caught by the first supporting member after dispensing of the first object.

At high processing speeds, it is critical that the dispensed objects are dispensed with a precise timing. Many conventional dispensers employ elaborate mechanical drive systems to actuate and time the dispensing process. Even with such actuating systems, many conventional dispensers are only capable of operating at levels to around at the most one hundred dispensed object per minute and may fail being reliable and simple to control and maintain. The dispenser of the present invention, however, is achieving speeds in excess of one hundred and eighty cycles per minute while accurate and reliably dispensing the objects. It may thus be seen that the present invention provides rapid and reliable dispensing of objects one at a time from a nested stack of objects.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the objects set forth together with other advantages which are obvious and which are inherent to the apparatus. As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.